

MARKSCHEME

May 2007

BIOLOGY

Higher Level

Paper 2

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Subject Details: **Biology HL Paper 2 Markscheme**

Mark Allocation

Candidates are required to answer **ALL** questions in Section A total **[32 marks]** and **any TWO** questions in Section B **[20 marks]** each. Maximum total = **[72 marks]**.

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- ♦ Each marking point has a separate line and the end is signified by means of a semicolon (;).
- ♦ An alternative answer or wording is indicated in the markscheme by a “/”; either wording can be accepted.
- ♦ Words in (...) in the markscheme are not necessary to gain the mark.
- ♦ Words that are underlined are essential for the mark.
- ♦ The order of points does not have to be as written (unless stated otherwise).
- ♦ If the candidate’s answer has the same “meaning” or can be clearly interpreted as being the same as that in the markscheme then award the mark.
- ♦ Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalizing them for what they have not achieved or what they have got wrong.
- ♦ Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- ♦ Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with “**ECF**”, error carried forward.
- ♦ Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by “**U-1**” at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- ♦ Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

Section B

Extended response questions - quality of construction

- ♦ Extended response questions for HL P2 carry a mark total of **[20]**. Of these marks, **[18]** are awarded for content and **[2]** for the quality of construction of the answer.
- ♦ Two aspects are considered:
 expression of relevant ideas with clarity
 structure of the answers.
- ♦ **[1]** quality mark is to be awarded when the candidate satisfies **EACH** of the following criteria. Thus **[2]** quality marks are awarded when a candidate satisfies **BOTH** criteria.

Clarity of expression:

The candidate has made a serious and full attempt to answer all parts of the question and the answers are expressed clearly enough to be understood with little or no re-reading.

Structure of answer:

*The candidate has linked relevant ideas to form a logical sequence **within** at least two parts of the **same question** (e.g. within part a and within part b, or within part a and within part c etc. but **not between** part a and part b or between part a and part c etc.).*

- ♦ It is important to judge this on the overall answer, taking into account the answers to all parts of the question. Although, the part with the largest number of marks is likely to provide the most evidence.
- ♦ Candidates that score very highly on the content marks need not necessarily automatically gain **[2]** marks for the quality of construction (and vice versa).
- ♦ The important point is to be consistent in the awarding of the quality points. For **sample scripts for moderation** the reason why quality marks have been awarded should be stated.
- ♦ Indicate the award of quality marks by writing **Q2, Q1 or Q0 in red** at the end of the answer.

SECTION A

1. (a) body mass increase with time;
increases are higher in early weeks / levels off; [2]

- (b) both groups show a growth in body mass;
growth in body mass is higher in the treated group;
growth in body mass is most significant in the early part of the experiment for both groups / levels off with time for both groups;
growth is more variable in control group / relationship less clear in control group; [3 max]

- (c) (i) body mass reaches maximum / begins to level off (as adult body size is reached) [1]

(ii) body mass begins to decline with age / curve slopes downward [1]

- (d) $\frac{5 (\pm 0.2)}{14.8 (\pm 0.2)} \times 100\%$;
 $= 34(\pm 3)\%$; (*units not required*) [2]

- (e) $50(\pm 5)$ mN (*units required*) [1]

- (f) treated group has greater overall body mass (suggest increase in muscle mass);
treated group has greater (EDL) muscle mass / $34(\pm 3)\%$ increase in muscle mass;
muscles of treated group have greater force of contraction;
treatment leads to slight improvements in length of contraction force;
support that the treatment is effective;
improvements are in a mouse model which may not have same outcome in humans; [3 max]

- (g) mRNA/gene (for dystrophin) isolated;
(if mRNA used) cDNA created;
gene/cDNA inserted into vector (such as a virus);
dose of (modified) vectors administered to affected individual;
genes taken up by host cells;
normal protein is expressed; [3 max]

- (h) antigens to the desired antibody are inserted into animal;
animal produces clone of desired B-cells;
relevant B-cells are isolated;
fused with tumor cells (to become immortal);
hybrid cells are maintained in culture medium / hybrid cells reproduce;
antibodies are continuously isolated from culture medium; [3 max]

2. (a) sample where all members of a population equally likely to be selected / sample selected without bias **[1]**
- (b) standard deviation is a measure of variability / measure of spread of data around mean;
high value (of standard deviation) indicates highly variable data / low value indicates low variability;
(high standard deviation leading to) overlap of two sets of data suggests no difference between the two; **[2 max]**
- (c) members of a population show variation;
variation has its origins in sexual reproduction / meiosis / mutation;
some variations allow an individual to be better adapted;
(better adapted varieties) survive to reproductive age;
frequency of advantageous alleles increases (over time); **[3 max]**
- (d) polygenic inheritance is when a characteristic/phenotype is determined by more than one gene;
as the number of genes involved increases, the number of intermediate phenotypes increases;
discrete groups become more difficult to recognize / phenotypes become continuous; **[2 max]**
3. (a) is transparent so it allows photosynthesis / capture of prey;
aquatic food chains can exist;
resists changes in temperature / has a high specific heat capacity;
provides a stable thermal environment;
water contains dissolved gases needed for life;
hydrogen bonding/surface tension enables water surface to be used as a habitat;
high boiling point means natural water habitats rarely boil;
when water cools/freezes it becomes less dense so ice forms at surface, providing insulation to water below, in which living organisms can survive; **[4 max]**
- (b) group of populations living (and interacting with each other) in an area **[1]**

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

4. (a) Award **[2 max]** for each structural level.
- primary structure is sequence / number of amino acids;
determined by base sequence in the gene;
(largely) determines higher level structures/secondary structure/tertiary structure;
- secondary structure is regular repeating patterns;
such as alpha/α helix and beta/β (pleated) sheet;
determined by H bonds (within chain);
contributes to the strength of fibrous proteins;
- tertiary structure refers to overall 3-D shape;
conformation can determine function;
tertiary structure determined by R-group interactions / ionic interactions /
hydrophobic interactions / disulfide bridges / H-bonds;
- quaternary structure is only found in proteins formed from more than one
polypeptide;
e.g. hemoglobin; (accept other suitable example)
quaternary structure may involve the binding of a prosthetic group; **[8 max]**
- (b) both are polymers of nucleotides / both nucleic acids;
sugar is deoxyribose in DNA and ribose in RNA;
DNA is double stranded and RNA is single stranded;
DNA has a (double) helix;
DNA has thymine while RNA has uracil; (*require full names written out*)
both contain four nitrogenous bases / A, G, C, T for DNA and A, G, C, U for RNA; **[4 max]**
- (c) membranes are surrounded by water;
hydrophilic molecules are attracted to water;
hydrophobic molecules are attracted to one another/repel water;
phospholipids are amphipathic/have a hydrophobic tail and a hydrophilic head;
tails are positioned away from water / heads are positioned towards water;
phospholipids have a hydrocarbon tail and a phosphate head;
phospholipid bilayer/membranes self-assemble in water;
protein association with membrane is determined by hydrophobic interactions;
phospholipid bilayer is hydrophilic on the outside and hydrophobic on the inside; **[6 max]**

(Plus up to **[2]** for quality)

5. (a) part maternal/part fetal tissue;
placenta grows into/is embedded in endometrium/uterus lining;
placental/chorionic villi are the site of exchange between maternal and fetal blood;
gas exchange / nutrient exchange / waste exchange;
site of exchange of antibodies from maternal to fetal blood;
produces HCG to maintain corpus luteum;
produces progesterone/estrogen to maintain pregnancy;
placenta connected to fetus via umbilical cord;
prevents blood mixing / incompatible proteins kept separate;
prevents damage from high pressure in maternal arteries; **[6 max]**
- (b) *Award [1] for each of the following structures clearly drawn and correctly labelled. Adjacent structures mentioned in each marking point must be recognizable in the drawing for the mark to be awarded, but need not be correctly labelled.*
testes/testis – shown inside scrotum;
sperm duct/vas deferens – shown linking to urethra;
penis – shown with erectile tissue inside;
urethra – shown linking bladder / upper side of prostate gland to end of penis;
epididymis – shown connected to sperm duct;
seminal vesicle – shown branched off sperm duct (not off the urethra);
prostate gland – shown positioned where sperm duct connects with urethra; **[5 max]**
- (c) *advantages: [5 max]*
genetic screening is the testing of an individual for the presence/absence of a particular gene/allele;
fewer children born with abnormalities / named genetic disorders;
parents can prepare for special needs of the child when it is born / early diagnosis leads to more effective treatment;
may help parents decide for an abortion;
positive step in evolution of human species as deleterious alleles become less common;
advanced notice allows more informed life choices;
confirmation of animal pedigrees;
- disadvantages: [5 max]*
may increase rates of abortion;
some tests give probability of disease rather than certainty;
false positives / false negatives;
advanced notice may create psychological issues;
may be abused by employers/insurance companies / privacy issues / immigration disputes;
ethical issues associated with gender/“ideal” phenotype/eugenics; **[7 max]**
Award [5 max] if only advantages or disadvantages are discussed.

(Plus up to [2] for quality)

6. (a) *Award credit for the following points if annotated on sketched graphs.*
 all three variables can be classified as limiting factors;
 as temperature increases, photosynthetic rate increases;
 maximum rate of photosynthesis at optimum temperature;
 at (very) high temperatures photosynthesis slows/stops;
 as light intensity increases, photosynthetic rate increases;
 at high light intensity, photosynthesis stops increasing;
 minimum light intensity necessary for photosynthesis to occur;
 (because concentration is rarely high) CO₂ is the main rate-limiting variable;
 as concentration of CO₂ rises, photosynthetic rate rises (up to a certain point); **[6 max]**
- (b) the function of most leaves is photosynthesis;
 they are broad and flat to maximize surface area (to volume ratio);
 palisade mesophyll is main photosynthetic tissue;
 it is near the surface / densely packed where the light intensity is highest;
 the cuticle prevents water loss;
 it is thicker on the upper surface where sunlight is more intense;
 the spongy mesophyll provides the main gas exchange surface;
 the vascular bundle transports materials such as sugars/water/minerals;
 it is centrally positioned near all tissues;
 xylem conducts water and minerals and phloem conducts sugars/amino acids;
 epidermal tissue covers the outside of the leaf and provides protection;
 the stomata are sites of water loss;
 they are on the lower surface/part of lower epidermis to prevent excessive water loss; **[8 max]**
- (c) *named non-endospermic seed: e.g. (kidney) bean/Phaseolus sp.;*
Award [3 max] for three of the following clearly drawn and correctly labelled.
 hypocotyl/radicle/embryo root;
 plumule/epicotyl/embryo shoot;
 testa/seed coat; (*clearly drawn as a layer or with some thickness*)
 micropyle;
 cotyledon; **[4 max]**

(Plus up to **[2]** for quality)

7. (a) *Award [1] for each of the following clearly drawn and correctly labelled.*
- loop of Henle;
 - ascending and descending;
 - proximal convoluted tubule; *(shown with convolutions)*
 - Bowman's capsule; *(shown as a continuation of proximal convoluted tubule)*
 - afferent arteriole;
 - efferent arteriole; *(with smaller diameter than afferent)*
 - distal convoluted tubule; *(shown with convolutions)*
 - collecting duct; *(shown with branches)*
 - fenestrated capillaries; *(shown as an enlarged diagram)*
- [4 max]**
- (b) ADH released (by the pituitary) when blood solute high;
 ADH makes cells of the collecting duct more permeable;
 more water is reabsorbed / concentrated urine produced;
 solute gradient within the medulla draws water from filtrate;
 leads to water reabsorption in the descending loop of Henle;
 ascending limb is impermeable to water (at upper reaches);
 (lower) ascending limb permeable to sodium ions/Na⁺ pumped out of (upper) ascending limb;
 which contributes to the establishment of a solute gradient;
 more Na⁺ at base of loop / deeper in medulla;
 some water re-absorbed in proximal convoluted tubule;
 capillaries associated with nephron absorb reclaimed water;
 once water level returns to normal/low blood solute, release of ADH stops;
 less water is reabsorbed / dilute urine produced;
- [8 max]**
- (c) root hair/root branching/cortex cells add surface area;
 plants actively transport minerals from soils;
 creating a solute gradient within the root;
 that draws water into the root through osmosis;
 (most) water travels through the apoplastic pathway/through cell walls;
 movement is by capillary action;
 some water travels via the symplastic pathway/through cell cytoplasm (and plasmodesmata);
 apoplast water cannot bypass Casparian strip of endodermis;
 enters xylem within vascular cylinder/stele;
- [6 max]**

(Plus up to [2] for quality)